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Dept. of Environmental Conservation  
Air Quality Section

March 6, 1990

Mr. Leonard D. Verrelli, Chief  
Air Quality Management  
Division of Environmental Quality  
Alaska Department of Environmental Conservation  
P.O. Box 0  
Juneau, Alaska 99811-1800

Dear Mr. Verrelli:

Re: Gas Handling Expansion -1 (GHX-1) Air Quality Permit Modification  
Clarification of Minor Outstanding Items

This letter addresses questions discussed with your staff during conference calls of February 23 and 28, 1990, regarding the subject application. In response to your staff's request, I am enclosing the vendor data sheet for Model P turbines which shows expected carbon monoxide (CO) emissions. Also during our discussion, a question developed concerning particulate matter emission factors. I have enclosed source test data from a 1979 source test at Prudhoe Bay which should clarify that issue.

During our conference calls, we reviewed many different emission factors for the several types of turbines and pollutants involved. To help clarify what was discussed, I have included summary information of approaches used by ARCO Alaska and ADEC for estimating emissions of CO, particulate matter, and nitrogen oxides (NOx).

# **1. CO Emission Factors for Model P, Model R and Model C Turbines**

## **Model P Turbines**

ADEC requested verification of the vendor's expected carbon monoxide emission rate for the Model P turbines. A vendor data sheet which provides this information is enclosed. The vendor expected emission rate of 11 pounds per hour, applied for a continuous operating period of 8760 hours per year, yields estimated potential CO emissions of 626 tons per year (tpy) for the 13 Model P turbines. The vendor's estimated emission rate corresponds to a fuel-dependent emission rate of 31 pounds per MMscf, using a Prudhoe Bay gas heating value of 865 BTU per scf. I mentioned the fuel-dependent emission rate of 31 pounds per MMscf for the purpose of comparison with the value used by ADEC.

To estimate Model P CO emissions, ADEC used a fuel-dependent emission rate of 158 pounds per MMscf which yields emissions of 3224 tpy. It appears ADEC obtained this value from Exhibit V of our response on November 22, 1989. Exhibit V compared permitted limits with performance data for the Model R turbine. The derived, average fuel-dependent emission rate for the Model R turbine was 15.8 pounds per MMscf, not 158 pounds per MMscf. Thus the ADEC estimate should be approximately 322 tpy of CO.

### Model R Turbines

Our application shows the maximum emission rate for the Model R turbine to be 41.5 pounds per MMscf during the past two years. This value was confirmed in the December 28, 1989, letter to ADEC. Using the recorded fuel consumption of 251.4 Mscf per hour yields maximum emissions of CO from the 13 Model R turbines of 595 tpy. These emissions are comparable to the expected emissions for the Model P turbines.

### Model C Turbines

By using the vendor guaranteed emission rate of 9 pounds per hour, the estimated annual emissions of CO are 118 tpy for the three Model C Turbines. ADEC has applied the BACT guideline figure of 109 pounds per MMscf which yields CO emissions of 546 tpy for the three Model C Turbines.

## **2. Particulate Emission Factors for Model P and Model C Turbines**

For both these turbines, our application shows emission estimates of 2.5 pounds per MMscf which yield annual particulate emissions of 51 tpy for the 13 Model P turbines and 13 tpy for the three Model C turbines. At fuel consumption rates of 371.7 Mscf and 383.3 Mscf for each Model P and C turbine, emission rates in pounds per hour are 0.9 and 1.0, respectively. The value 2.5 pounds per MMscf comes from Table 1.4-1, AP-42, Uncontrolled Emission Factors for Natural Gas Combustion, August 1982.

ADEC estimated particulate emissions for the Model P and C Turbines by using an emission factor of 14 pounds per MMscf from Table 3.3 1-2, Composite Emission Factors for 1971 Population of Electric Utility Turbines. This emission factor results in emission rates of approximately 5 pounds per hour, yielding 285 tpy for the 13 Model P Turbines and 70 tpy for the three Model C Turbines.

As supporting documentation for using lower emission rates than being proposed by ADEC, I am enclosing source test results from the Central Power Station, Flow Station 1, and the Central Compressor Plant, submitted by Radian Corporation on August 10, 1979. This report shows particulate emissions less than 1 pound per hour for CCP and CPS and 0.25 pound per hour for Flow Station 1. We used the emission factor from Table 1.4-1 because it is more recent data than Table 3.3 1-2, and it more closely approximates the source test data. Table 3.3 1-2 is fairly old data, and an emission factor that more closely approximates vendor data and source test data would be more reasonable.

## **3. NOx Emission Factors for Model P and Model C Turbines**

In our application, we used the vendor's expected emission rate of 137 ppm for the Model P turbine and the vendor's guaranteed rate of 150 ppm for the Model C turbine. These rates were confirmed in Exhibit I of our response on November 22, 1989. These rates yield NOx emissions of 9982 tpy for the 13 Model P turbines and 2602 tpy for the three Model C turbines.

ADEC estimated emissions by applying the BACT guideline formula to the vendor's expected and guaranteed emission rates. ADEC's computations result in emission rates

of 116 ppm for the Model P and C turbines, rates that the vendor cannot guarantee. These rates correspond to annual NOx emissions of 8313 tpy for the 13 Model P turbines and 1800 tpy for the three Model C turbines.

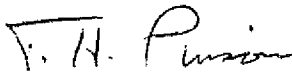
In summary, I have enclosed the vendor's data sheet for the Model P turbines which verifies the emission rate for CO at 11 pounds per hour. I expect this rate to more closely approximate annual CO emissions than the ADEC BACT guideline rate of 109 pounds per MMscf.

I have also enclosed a source test summary, dated August 10, 1979. This sheet verifies particulate emissions of generally less than one pound per hour. By conservatively estimating particulate emissions at 1 pound per hour, I can support the use of an emission factor of 2.5 pounds per MMscf rather than 14 pounds per MMscf.

Also, I am concerned about the use of the ADEC BACT guideline for NOx being applied to the vendor's expected and guaranteed emission rates. Vendor products may not be able to meet these guidelines.

Should you have questions, please contact Randy Poteet at 263-4741.

Sincerely,



Timothy H. Pinson  
GHX Permit Director

Enclosure

cc: J. Coutts, ADEC, Fairbanks  
S Hungerford, ADEC, Juneau  
M. Lim, ADEC, Juneau

ARCO ALASKA PRUDHOE BAY  
P/NT UPRATE FOR MODEL 5R TURBINES

ESTIMATED EMISSION DATA AT THE FOLLOWING CONDITIONS :  
AMBIENT TEMPERATURE 59 DEGREES, 60% RELATIVE HUMIDITY AND 14.7 PSIA  
5.5/6.6 INCHES WATER INLET/EXHAUST PRESSURE DROPS  
TURBINE IN NEW AND CLEAN CONDITION  
FUEL : NATURAL GAS \*

ESTIMATED EMISSIONS P/NT CONFIGURATION

NOX PPMVD	123
NOX PPMVD @ 15% O2	137
NOX #/HR	172
CO PPMVD	12
CO #/HR	11
UHC + PPMVW	7
UHC + #/HR	5
SO2 PPMVW	6
SO2 #/HR	13
PARTICULATES #/HR	2.5 $\approx$ 6.8 lb/mm scf

EST. EXHAUST GAS FLOW #/HR X 1E3 983.7

EST. EXHAUST GAS ANALYSIS, % VOLUME

ARGON	0.90
NITROGEN	75.26
OXYGEN	14.93
CARBON DIOXIDE	2.66
WATER	6.25

+ UHC : UNBURNED HYDROCARBONS

\* NATURAL GAS PER GAS ANALYSIS BELOW :

	VOL %
METHANE	81.57
CARBON DIOXIDE	11.85
ETHANE	4.44
PROPANE	1.12
NITROGEN	0.72
BUTANE	0.16
PENTANE	0.04
H2S	160 PPMVW
FUEL LHV	847.9 BTU/SCF

ALL OF THE NITROGEN IS ASSUMED TO BE N2, AND THEREFORE IS NOT FUEL BOUND NITROGEN

D. TRAYHAN  
10/10/89

ESTIMATE  
EMISSIONS



TABLE 1-1. SUMMARY OF THE AVERAGE VALUES OF TURBINE EMISSIONS DATA OBTAINED DURING 31 OCT. - 7 NOV., 1978, PRUDHOE BAY FACILITIES, ALASKA

Turbine Identification	Load	% Maximum Load	NO <sub>x</sub> <sup>1,2</sup> (ppmv)	Calculated O <sub>2</sub> (%)	SO <sub>x</sub> (ppmv)	Particulates (lbs/hr)	H <sub>2</sub> O <sup>3</sup> (%)	Stack Temperature (°F)	Exhaust Gas Flow <sup>4</sup> (SCFM)
CPS (Unit 6)	16.5 MW	67	50 ± 12	16.9	<1	<1	3.5	739	244,000
Flow Station 1 (Unit 1802)	11,900 HP	97+	36 ± 13	17.1	<1	0.25	3.3	582	155,000
CCP (Unit 1804)	21,500 HP	97.5	66 ± 6	16.0	1.5	<1	4.5	756	167,000

<sup>1</sup>The NO<sub>x</sub> values are corrected to 15% O<sub>2</sub> and ISO Standard Day Conditions, the NO<sub>x</sub> was essentially all NO.

<sup>2</sup>The error limits are based on the difference between measured exhaust flow rate and design flow rate at the machine load during the test period.

<sup>3</sup>Calculated from measured gas flow rate and design combustion efficiency.

<sup>4</sup>Standard conditions are dry, 20°C and 760 mmHg.